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(54) Paper Machine Clothing

(57) The invention pertains to paper machine clothing, especially a forming or drying screen, with a paper side and machine side, in which the paper side is formed of plastic elements (1, 11, 21, 31), for example in the form of a belt layer, threads, spirals or flat wales or the like, and in which the plastic elements are provided with an anti-adhesive coating (5, 6, 14, 15, 24, 25, 34, 35), at least on the surfaces forming the paper side, whose adhesion is less than the adhesion of the material, of which the plastic elements (1, 11, 21, 31) essentially consist, characterized by the fact that the plastic elements (1, 11, 21, 31) have recesses (3, 4, 12, 13, 22, 23, 32, 33), at least on the paper side, in which the anti-adhesive coating (5, 16, 14, 15, 24, 25, 34, 35) is incorporated.

Description

[0001] The invention concerns paper machine clothing, especially forming or drying screens, with a paper side and a machine side, in which the paper side is formed of plastic elements, for example in the form of a belt layer, threads, spirals, flat wales or the like, and in which the plastic elements on the paper side are provided with an anti-adhesive coating, whose adhesion is less than the adhesion of the material of which the plastic elements essentially consist.

[0002] Paper machine clothings are long and wide belts that serve for forming and transporting the paper web in a paper machine. They are designed endless and revolve around rolls in the paper machine. The outer flat side forms the paper side, because the paper web is transported on it. The inner flat side is referred to as the machine side, because it runs over the rolls of the paper machine.

[0003] A paper machine has essentially three sections, also called parts. In the first part, the sheet-forming section, forming screens are used as paper machine clothing. They generally consist of fabrics produced from monofilaments. The task of the forming screen is paper web formation and drainage of the paper web through the forming screen. In the next part, the press section, the paper web is exposed to high pressure for further drainage. Press felts are used, in particular, in the press section, which consist of a woven or knitted support and a nonwoven needled onto it (cf. US 4,943,476). In the subsequent dryer section, the paper web is thermally drained and then passed over heated rolls by means of drying screens. There are numerous variants of drying screens, mainly as woven fabrics (cf. US 4,621,663 - knitted fabrics have also been proposed - or as so-called wire link belts (cf. DE 24 19 751 C3, US 4,796,749, US 5,534,333)). Such wire link belts consist of spirals extending across the running direction, which are coupled to each other via coupling wires. In addition, there are also proposals to assemble a paper machine clothing from a number of flat wales extending across the running direction, which are connected to each other via coupling wires (cf. DE 37 35 709 C2; EP 1 035 251 A1). Paper machine clothings that consist of porous plastic layers or plastic layers provided with perforations are also known (cf. EP 0 817 886 B1; US 4,541,895; WO 92/17643).

[0004] In addition to the aforementioned paper machine clothings, there are also auxiliary belts, such as transfer belts to transfer the paper web from one to another part, and also shoe press belts. Like the aforementioned paper machine clothings, they are adapted to the corresponding purpose with respect to surface configuration and structure.

[0005] Apart from felts as paper machine clothings, the surfaces of such paper machine clothings are formed by plastic elements. In woven and knitted fabrics, these are threads, especially monofilaments. In wire link belts (cf. US 4 796 749), the surfaces are formed by the spirals. The same applies to paper machine clothings made of flat wales or extruded segments (cf. DE 37 35 709 C2; EP 1 036 251 A1). Paper machine clothings that have a plastic layer, at least on one side (generally the paper side), or consist of such a layer have very smooth surfaces (cf. EP 0 817 886 B1).

[0006] The problem exists that soiling, in the form of small particles, can deposit on the paper sides of paper machine clothings and build up to larger dirt deposits. They originate from the raw material of papermaking. The source of the particles is mostly scrap paper. However, pulp also entrains adhesive contaminants in certain seasons. The variations in contaminants range from tree resins, oils, glues to printer inks, etc. The contaminants hamper production of the paper web and result in situations in which the paper machine clothing must be cleaned in the paper machine or even prematurely replaced.

[0007] Demanding and expensive efforts have been made to remove or mask the contaminants from the paper raw material before production of the paper web. Attachment of contaminants to the paper machine clothing still invariably occurs. Attempts have therefore been made to equip the plastic elements of the paper machine clothings forming the flat sides with an anti-adhesive coating, for example from fluorocarbons or silicone compounds. The dirt particles adhere to such coatings less well than to the material of which the plastic elements are made. The effect of the anti-adhesive coatings, however, is only of short duration, since they are rubbed off by abrasion from the surface of the paper machine clothing.

[0008] A paper machine clothing is disclosed in US 4,541,895, constructed of a number of layers provided with perforations. It is proposed to form recesses in the layer on the paper side and incorporate detergents in these recesses. During operation of the paper machine clothing, the detergent is slowly released from the recesses to the wash liquor and a self-cleaning effect is supposed to be achieved by this. However, with such detergents, the contaminants of the aforementioned type cannot be removed. In addition, they are only effective in an aqueous environment and have a tendency toward foam formation. The washing effect ends as soon as the detergent is used up by continuous release.

[0009] A proposal is made in WO 01/21884 A1 to give the plastic elements that form the surface facing the paper web (paper side) a roughness with a depth of roughness between 5 μm and 100 μm and, in so doing, prevent deposition of contaminants. The basic idea here is not to offer the dirt particles a continuous larger contact area that could serve as an adhesion surface. Because of this, a significantly improved loosening of dirt particle agglomerations is supposed to be achieved and the buildup of such aggregation to sizes that lead to adverse effects on quality in the paper web is avoided. The effect of this expedient, however, is not satisfactory, especially in dust- and powder-like deposits.

[0010] The underlying task of the invention is to design a paper machine clothing so that deposition of dirt particles is more effectively and more permanently avoided than in the known paper machine clothings.

[0011] This task is solved according to the invention in that the plastic elements have recesses, at least on the paper side, in which an anti-adhesive coating is incorporated. Paper machine clothings equipped with an anti-adhesive coating are therefore resorted to in the invention. In contrast to previously known application methods, however, the anti-adhesive coating is incorporated in recesses that are formed in the plastic elements, preferably flush with the surfaces of the plastic elements forming the paper side. This results in areas with anti-adhesive effects on the paper side, which prevent the deposition of dirt particles. This effect is also long-lasting, because the anti-adhesive coating is protected in the recesses and is only abraded according to the abrasion of the plastic elements themselves. The depth of the recesses can be adjusted so that sufficient anti-adhesive coating is available to the end of the lifetime of the paper machine clothing.

[0012] In this case, no disturbance is caused, if, during the production process, the surface regions of the plastic elements lying between the recesses are provided with an anti-adhesive coating. This part of the anti-adhesive coating will naturally not reach a long lifetime, because of abrasion. The anti-adhesive coating situated in the recesses and its long-lasting anti-adhesive effect, however, is unaffected by this and reliably prevents deposition of dirt particles.

[0013] The anti-adhesive effect can be adjusted by the shaping, size and distribution of recesses, so that, on the one hand, the strength of the plastic elements and their abrasion resistance is not significantly reduced, or reduced only within an admissible range, and, on the other hand, the anti-adhesive effect is as optimal as possible, so that cleaning of the paper machine clothing is not necessary, or only necessary at long intervals.

[0014] In a design of the invention, it is provided that the recesses have V- or U-shaped cross sections. However, other cross-sectional shapes are conceivable. They can be formed as individual blind holes. However, formation of the recesses as grooves is favorable for manufacture, because they can already be formed during extrusion of the plastic elements through corresponding nozzle molds. The grooves can be linear, but also wave-like or meandering.

[0015] In order to make available the largest possible anti-adhesive surface, the recesses can be directly adjacent to each other at their edges. In order to achieve good abrasion resistance of the surface of the plastic elements, however, it can also be expedient to space the recesses so that surface regions consisting of the material of the plastic elements are situated between them.

[0016] Implementation of the basic idea of the invention is considered in all plastic elements that form the paper side. Flat threads, whose height is smaller in the direction across the plane of the paper machine clothing than their width, are particularly suitable, because they have a large surface for forming recesses on the paper side. The flat surfaces need not have a rectangular cross section, but can also have a trapezoidal or oval, or also different outline. The flat threads can be incorporated in a woven or knitted fabric, but also form the spirals of wire link belts. Instead of this, there is a possibility of assembling the plastic elements from several round individual threads that are melted together (cf. US 5,591,525). Profiled cross-sectional shapes are also considered, for example as known from DE 40 31 608 A1, US 5,361,808, EP 1 067 239 A2, EP 0 995 835 A1, US 3,158,984 and GB 1 053 282. The recesses should extend in the longitudinal direction in such elongated plastic elements.

[0017] The recesses should have a depth between 10 and 50% of the extent of the plastic elements in the depth direction.

[0018] It is understood that the arrangement of recesses with the anti-adhesive coating incorporated in them need not be restricted to the paper side. Such recesses should be provided everywhere deposits of dirt particles occur. This can also be on the side of the plastic elements facing away from the paper side. Recesses with an anti-adhesive coating can also be provided with plastic elements that are surface-forming on the machine side.

[0019] All thermoplastics or similar polymers are considered as material for the plastic element, like those used ordinarily for production of paper machine clothings. Examples of such materials are PET, PPS, PP, PA, PS, PEN, PEK and/or PEEK, as well as mixtures of these materials. Materials that have already been used for anti-adhesive coating are suitable as materials for the anti-adhesive coating, such as silicones, fluorocarbons or fluoroethylenes.

[0020] The invention is further explained in the drawing by means of practical examples. In the drawing:

Figures 1 to 4 show different cross-sectional shapes of flat threads for paper machine clothings.

[0021] The flat thread 1 depicted in Figure 1 consists of five individual threads, circular in cross section (denoted 2), which are arranged next to each other in one plane and are melted together. Flat-V-shaped recesses (denoted 3 on the top and 4 on the bottom) are formed thereby on the top and bottom of flat thread 1. The recesses 3, 4 are all filled with anti-adhesive coatings (denoted 5 on the top and 6 on the bottom), flush with the individual threads 2. The recesses 3, 4, and therefore the anti-adhesive coatings 5, 6, extend in the longitudinal direction of the flat thread 1, i.e., perpendicular to the plane of the drawing, like the flat thread 1. The anti-adhesive coatings 5, 6 prevent deposition of dirt particles on the top and bottom surfaces of flat thread 1.

[0022] The flat thread 11, depicted in Figure 2, has a rectangular cross section. U-shaped recesses (denoted 12 on the top and 13 on the bottom) are formed over the top and bottom of flat

thread 11. The recesses 12, 13 extend in the longitudinal direction of flat thread 11, i.e., perpendicular to the plane of the drawing. Anti-adhesive coatings (denoted 14 on the top and 15 on the bottom) are incorporated in the recesses 12, 13. Surface sections of flat thread 11 from this material extend between the recesses 12, 13. The abrasion resistance of this material only permits limited wear, so that the incorporated anti-adhesive coatings 14, 15 are available during the entire running time of the paper machine clothing from such flat threads 11.

[0023] A flat thread 21 that is essentially rectangular but tapers conically toward both sides is depicted in Figure 3. On the top and bottom, the flat thread 21 has V-shaped recesses in cross section (denoted 22 on the top and 23 on the bottom), which are filled with anti-adhesive coatings (denoted 24 on the top and 25 on the bottom). The recesses 22, 23 extend parallel to each other in the longitudinal direction of flat thread 21, i.e., perpendicular to the plane of the drawing.

[0024] The flat thread 31 depicted in Figure 4 does not differ significantly from the flat thread 21 depicted in Figure 3. It has a strictly rectangular cross section, whose V-shaped recesses extend in the longitudinal direction (denoted 32 on the top and 33 on the bottom), which are filled with anti-adhesive coatings (denoted 34 on the top and 35 on the bottom). As in the example according to Figure 3, the recesses 32, 33 are directly adjacent to each other, so that no surface regions of the material of flat thread 31 itself remain between them. However, increasingly wider regions are formed by abrasion.

Claims

1. Paper machine clothing, especially forming or drying screen, with a paper side and a machine side, in which the paper side is formed by plastic elements (1, 11, 21, 31), for example in the form of a belt layer, threads, spirals or flat wales, and in which the plastic elements, at least on the surfaces forming the paper side, are provided with an anti-adhesive coating (5, 6, 14, 15, 24, 25, 34, 35), whose adhesion is less than the adhesion of the material of which the plastic elements (1, 11, 21, 31) essentially consist, **characterized by the fact** that the plastic elements, (1, 11, 21, 31) have recesses (3, 4, 12, 13, 22, 23, 32, 33), at least on the paper side, in which the anti-adhesive coating (5, 6, 14, 15, 24, 25, 34, 35) is incorporated.
2. Paper machine clothing according to Claim 1, **characterized by the fact** that the recesses (3, 4, 12, 13, 22, 23, 32, 33) are filled to the surface of the plastic elements (1, 11, 21, 31) flush with the anti-adhesive coating (5, 6, 14, 15, 24, 25, 34, 35).
3. Paper machine clothing according to Claim 1 or 2, **characterized by the fact** that the recesses (3, 4, 12, 13, 22, 23, 32, 33) have a V-, U-, trapezoid- or pore-shaped cross section.
4. Paper machine clothing according to one of the Claims 1 to 3, **characterized by the fact** that the recesses (3, 4, 12, 13, 22, 23, 32, 33) are formed as grooves.
5. Paper machine clothing according to one of the Claims 1 to 4, **characterized by the fact** that the recesses (22, 23, 32, 33) are directly adjacent to each other at their edges.

6. Paper machine clothing according to one of the Claims 1 to 5, **characterized by the fact** that the plastic elements are formed as flat threads (1, 11, 21, 31).
7. Paper machine clothing according to Claim 6, **characterized by the fact** that the flat threads (1, 11, 21, 31) have a rectangular, trapezoidal or oval outline.
8. Paper machine clothing according to one of the Claims 1 to 7, **characterized by the fact** that the plastic elements (1) are assembled from several round individual threads (2) that are melted together.
9. Paper machine clothing according to one of the Claims 1 to 8, **characterized by the fact** that the recesses (3, 4, 12, 13, 22, 23, 32, 33) extend along the plastic elements (1, 11, 21, 31).
10. Paper machine clothing according to one of the Claims 1 to 9 **characterized by the fact** that the recesses (3, 4, 12, 13, 22, 23, 32, 33) have a depth between 10 and 50% of the extent of the plastic elements (1, 11, 21, 31) in the depth direction.
11. Paper machine clothing according to one of the Claims 1 to 10, **characterized by the fact** that the recesses (4, 13, 23 33) are also present on the side of the plastic elements (1, 11, 21, 31) facing away from the paper side.
12. Paper machine clothing according to one of the Claims 1 to 11, **characterized by the fact** that the machine side of the plastic elements (1, 11, 21, 31), having recesses (3, 4, 12, 13, 22, 23, 32, 33), is also formed of, in which the anti-adhesive coatings (5, 6, 14, 15, 24, 25, 34, 35) is incorporated.

//insert Figures 1-4//

RELEVANT DOCUMENTS			
Category	Citation of document with indication to the extent possible of the relevant passages	Relates to Claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ⁷)
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			SUBJECT AREAS SEARCHED (Int. Cl. ⁷)
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The present search report was prepared for all patent claims			
Search location MUNICH		Date search completed 13 November 2003	Authorized officer Maisonnier, C
CATEGORY OF CITED DOCUMENTS		T: theories or principles underlying the invention	
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P: interim literature		&: document member of the same patent family, same document	

ADDENDUM TO EUROPEAN SEARCH REPORT**CONCERNING EUROPEAN PATENT APPLICATION NO.****EP 03 01 8342**

The members of the patent families of the patent documents listed in the aforementioned European Search Report are stated in this addendum.

Information concerning family members corresponds to the status of the file of the European Patent Office on 11-13-2003

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